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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/824,288	04/13/2004	Max Shtein	12992/90501	6049

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EXAMINER	
SUCH, MATTHEW W	
ART UNIT	PAPER NUMBER
2891	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/824,288	SHTEIN ET AL.	
	Examiner	Art Unit	
	Matthew W. Such	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 October 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 October 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-3, 9-11, 17-19, 24-26 and 33-34 are rejected under 35 U.S.C. 102(b) as being anticipated by Han ('665).

a. Regarding claims 1, 17, 33 and 34 Han teaches a method for forming optoelectronic devices wherein a first layer (Element 4) over a first electrode (Element 7) by an organic vapor phase deposition (see Para. 0044 for vapor deposition of organic semiconductor). The first layer comprises a first organic small molecule material, such as phthalocyanine (Para. 0023, 0033, etc.) A second layer (Element 3) is deposited on the first layer such that the first and second layers are in physical contact (see the contact line at Element 4). The interface provides a "bulk heterojunction" since it has some protrusions (as shown in, for example, Fig. 1). A second electrode (Element 2) is deposited over the second layer. The Examiner notes that the device can be turned upside

down and the Elements inverted since the terms "first layer" and "second layer" are completely arbitrary (for example, Element 2 can be a first electrode and Element 7 can be a second electrode).

b. Regarding claims 2-3 and 18-19, Han further teaches that the first layer can be an electron donor layer, the first electrode can be an anode, the second layer can be an electron acceptor layer and the second electrode can be a cathode (Para. 0036-0042). The Examiner notes that the device can be turned upside down and the Elements inverted since the terms "first layer" and "second layer" are completely arbitrary (for example, Element 2 can be a first electrode and Elements 6 and 7 can be a second electrode).

c. Regarding claims 9 and 24, the manner in which the claim is written does not distinguish the invention from the prior art since the first organic molecule has some tendency to adhere to itself or the layer could not exist.

d. Regarding claims 10-11 and 25-26, Han further teaches that the first layer can be over a substrate (Element 1 or 8), which can be plastic (Para. 0019).

3. Claims 1-5, 8-11, 17-19, 23-26 and 33-34 are rejected under 35 U.S.C. 102(e) as being anticipated by Foust (`508).

a. Regarding claims 1-2, 8-11, 17-18, 23-26, and 33-34, Foust teaches a method for producing and optoelectronic device by depositing organic layers on a plastic substrate (Paragraphs 0016-0018) with an indium-tin-oxide (ITO) electrode (Paragraph 0024) by an organic vapor phase deposition (OVPD) method (Paragraphs 0007 and 0034). Organic compounds and other layers have some roughness wherein a first layer tends to adhere to itself, even at the atomic scale, inherently forming protrusions since Foust teaches the method as disclosed in the claims 1 and 17.

Foust teaches that an electron donor layer of copper phthalocyanine (CuPc) is deposited on ITO (Paragraph 0028). The CuPc layer adheres to itself as well the electrode on which it is deposited, rather than the substrate, since the electrode covers the substrate. An electron acceptor layer of buckminsterfullerene (C60) is deposited directly on CuPc (Paragraph 0029) and a second electrode is formed over the structure (Paragraphs 0030-0031 and 0035).

b. Regarding claims 3 and 19, Foust teaches the device may be deposited in reverse since the ITO electrode can form the cathode (Paragraph 0026).

c. Regarding claims 4 and 5, Foust teaches that the surface area to volume ratio of the first layer is at least 5:1. The surface area to volume ratio is defined by:

$$Ratio = \frac{Area}{Volume},$$

and the surface area is all sidewalls plus both a bottom and upper surface of a layer. Foust shows that metal grids (Element 22) are 1 inch by 1 inch squares which are

located 2-4 inches apart. Therefore, the incident light area defined by the upper interface and lower interface is on the order of inches or at least centimeters. Since the thickness on the first layer is (at its thickest possibly contemplated), one molecular layer less than, for example, 2500 Angstroms (Para. 0026), then the surface area to volume ratio is geometrically required to be several orders of magnitude higher than 5:1.

4. In so far as definite, claims 1-2, 7, 9-13, 22, 25-28 and 33-34 are rejected under 35 U.S.C. 102(e) as being anticipated by Forrest ('445).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

a. Regarding claims 1-3, 7, 9-11, 17-19, 22, 25-26 and 33-34, Forrest teaches a method for forming an optoelectronic device wherein any of the organic layers can be deposited by organic vapor phase deposition (OVPD) on a plastic substrate (Col. 7, Lines 65-67; Col. 8, Lines 16-18; Col. 14, Lines 21-28; Fig. 1).

A first layer is a electron donor layer of CuPc (Col. 8, Lines 60-64) and a second layer is an electron acceptor layer of PTCBI (Col. 8, Lines 64-67; Col. 9, Lines 1-6) are

deposited on a first electrode, and ITO electrode (Col. 8, Lines 11-12 and 16-18). The first electrode can be an anode, which tends to be very rough, and induce protrusions in the deposited first layer (Col. 13, Lines 58-60). A second electrode, a cathode, is deposited over the structure (Col. 9, Lines 24-43). The device may be deposited in reverse (Col. 3, Lines 34-49; Col. 10, Lines 53-56; Col. 13, Lines 16-18).

b. Regarding claims 12-13 and 27-28, Forrest teaches a BCP exciton blocking layer is formed between the second layer and a second electrode (Col. 9, Lines 7-23).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Han ('665) who teaches of first layer thickness of, for example, about 0.01 microns (Para. 0036). The surface area to volume ratio is defined by:

$$Ratio = \frac{Area}{Volume},$$

and the surface area is all sidewalls plus both a bottom and upper surface of a layer. Han teaches a thickness for a first layer that is about, for example, 0.01 microns, which leaves only the surface area on the bottom and upper surfaces as undefined.

However, one would be motivated to set the top and bottom surface area to be as large as possible, such as on the order of meters, in order to produce a large area for incident light. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to set the surface area to volume ratio to be greater than 5:1 in microns since in order to produce economic quantities of current the area for incident light of a photoelectric conversion device is preferably on any size that is beyond the scale of microns. It has been held that where the general conditions of a claim are disclosed in prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Foust (`508) in view of Forrest (`102).

Foust teaches the method of claim 1 wherein organic semiconductor molecules can be deposited by OVPD at low temperatures and pressures but does not teach specific conventional details such as the substrate temperature and chamber pressure (Foust Paragraph 0034).

Forrest teaches OVPD method for depositing organic semiconductor molecules into layers. It would have been obvious to one of ordinary skill in the art at the time the invention was made to deposit the organic layers of Foust by using a substrate temperature of 15 degrees Celsius and a pressure of 0.65 Torr as taught by Forrest in order to maintain surface integrity and

quality of the layers (Forrest Col. 8, Lines 5-51). Furthermore, Foust teaches that it is desirable to maintain low processing temperatures during construction of the organic devices to maintain the integrity of the organic layers (Foust Paragraph 0038). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

8. Claims 7 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).

Foust teaches the methods of claims 1 and 17 where first and second organic semiconductor layers of CuPc and C60, respectively, are formed to produce an optoelectronic device (Foust Paragraphs 0028-0029). Foust does not teach using the specific compound 3,4,9,10-perylenetetracarboxylic bis-benzimidazole (PTCBI) as an electron acceptor layer.

Forrest also teaches forming layers of CuPc and C60, or in the alternative CuPc and PTCBI, as an electron donor and electron acceptor layer, respectively (Paragraphs 0034, 0044-0045 and 0062-0065). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use PTCBI in place of C60 for an electron acceptor layer since the compounds are functional equivalents. It has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in Sinclair & Carroll Co. v.

Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945) See also In re Leshin, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

9. Claims 12-13 and 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust (`508) in view of Forrest (`846).

Foust teaches the methods of claims 2 and 18 where the optoelectronic device formed by first and second organic semiconductor layers functions as a photovoltaic or light emitting device (Foust Paragraphs 0005-0007). Foust teaches using a reflective top electrode material to reflect light either generated from the active region or capture additional light from an external source, increasing the efficiency of the device (Foust Paragraphs 0005-0008 and 0035). Furthermore, Foust teaches the use of phosphor particles in the device to convert sunlight wavelengths to wavelength which are more readily adsorbed by the organic active layers as well as to enhance light trapping (Foust Paragraph 0022). Foust does not teach additional alternative methods for enhancing the efficiency of the device.

Forrest teaches depositing an exciton blocking layer of BCP material between the second layer and the second electrode (Forrest Paragraphs 0022-0030). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add a BCP exciton blocking layer taught by Forrest to the methods taught by Foust in order to increase the photocurrent density of the photovoltaic device and improve efficiency (Forrest Paragraphs 0026-0030, 0051-0052 and 0062-0067; Figs. 1-2 and 5).

10. Claims 14-16 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).

Foust teaches the methods of claims 1 and 17 wherein PEDOT/PSS material can be used as an organic semiconductor material in the device which can be deposited by OVPD (Foust Paragraphs 0027 and 0034). However, Foust does not teach using the PEDOT/PSS layer in tandem with the CuPc and C60 layers to form a device.

Forrest teaches using PEDOT/PSS layers on an the ITO electrode in order to planarize the surface and prevent shorting instances in the devices (Forrest Paragraph 0057). Although, Foust does not teach using a PEDOT/PSS layer as a planarization over the second organic semiconductor layer below the second electrode, Foust does teach minimization of shorting is desirable. Foust teaches methods where the devices are segmented into discrete elements in order to prevent short circuits in one area of the device from shorting the entire layer set (Foust Paragraph 0035). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to add a PEDOT/PSS layer as a planarizing layer over the ITO layer and under the second electrode in order to planarized the electrode surfaces and reduce instance of shorting in the devices.

11. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('462).

Foust teaches the method of claim 17 wherein one layer of an organic region is an electron acceptor and another layer is an electron donor and that electron-hole pairs created by absorption of photons must be dissociated to generate a current (Foust Paragraph 0007). Foust is silent, however, regarding specifically describing methods to increase the dissociation of charges.

Forrest teaches methods for forming organic photovoltaic devices having an electron acceptor layer and electron donor layer wherein charge dissociation efficiency is related to active layer thickness and interfacial geometry (Forrest Paragraph 0020). Forrest further teaches that nanotextured materials having repeated interfaces or highly folded interfaces can offer improvement of charge collection (Forrest Paragraph 0022). The exciton diffusion length should be greater than the layer thickness, or protrusion diameter, to avoid electron-hole recombination (Forrest Paragraph 0020). The thickness should not be so large as to reduce the strength of dissociation-assisting electric fields, leaving an optimum range for the thickness, or protrusion diameter (Forrest Paragraph 0020).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to set the diameter of protrusions to be 1.5 to 3 times the exciton diffusion length to optimize the charge carrier dissociation efficiency by controlling the surface interface as described above. It has been held that where the general conditions of a claim are disclosed in prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

12. Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust (`508) in view of Forrest (`846).

Foust teaches the methods of claims 1 and 17 where the optoelectronic device formed by first and second organic semiconductor layers functions as a photovoltaic or light emitting device (Foust Paragraphs 0005-0007). Foust teaches using a reflective top electrode material to reflect light either generated from the active region or capture additional light from an external source, increasing the efficiency of the device (Foust Paragraphs 0005-0008 and 0035). Furthermore, Foust teaches the use of phosphor particles in the device to convert sunlight wavelengths to wavelength which are more readily adsorbed by the organic active layers as well as to enhance light trapping (Foust Paragraph 0022). Foust does not teach additional alternative methods for enhancing the efficiency of the device.

Forrest teaches depositing a gold layer as an electron-hole recombination site over a second organic layer, such as PTCBI (Forrest Paragraphs 0062-0065; Fig. 1 and 2). This deposition is followed by a third and fourth layer between over the gold recombination zone and an electrode over the entire structure (Forrest Paragraphs 0023, 0062-0065; Fig. 1 and 2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add a gold electron-hole recombination layer and a third and fourth organic semiconductor layer over the second organic semiconductor as taught by Forrest to the methods taught by Foust. One would have been motivated to do so to increase the efficiency of the photovoltaic device by boosting photo voltage (Forrest Paragraphs 0023-0024 & 0063; Fig. 3).

Response to Arguments

13. Applicant's arguments filed 23 October 2006 have been fully considered but they are not persuasive. The Applicant's argue that the prior art does not teach a "bulk heterojunction". The Examiner notes that the manner in which the claim is written does not limit the degree to which protrusions or interpenetration occurs at the interface between the first layer and the second layer. Therefore, *any two layers*, meet the claim since all layers have at least some protrusions or interpenetration, even if it occurs only at the atomic scale.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Forrest (`007), Shiratsuchi (`176), Yamazaki (`701), Halls (`950), Kayama (`504), Saurer (`570), Fujimori (`649), Den (`824) and Han (`605) each teach various configurations for photoelectric conversion devices.

Contact Information

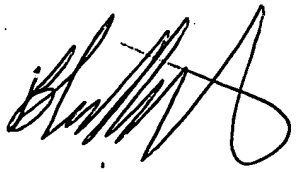
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Such whose telephone number is (571) 272-8895. The examiner can normally be reached on Monday - Friday 9AM-5PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bradley W. Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew W. Such
Examiner
Art Unit 2891

MWS
12/26/06



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